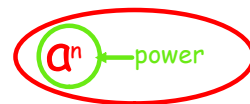


6.1 The Laws of ExponentsDefinition of a power of a number

$$2 \times 2 \times 2 \times 2 \times 2 = 2^5$$

$$3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^9$$

$$(-5)(-5)(-5)(-5)(-5) =$$

$$\underbrace{a \times a \times a \times a \times a \times a \times a \times a \times a \times \dots \times a}_{n \text{ times}} = a^n$$

exponent

base

Multiplying Powers with the same base:

$$(4^3)(4^7) = 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^{10}$$

$$(9^4)(9^5) = 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 = 9^9$$

State a rule for multiplying powers with the same base:



$$a^n \times a^m = a^{n+m}$$

Ex 1:

$$\begin{aligned} \text{a) } (-5)^3 \times (-5)^2 &= (-5)^{3+2} \\ &= (-5)^5 \end{aligned}$$

$$\begin{aligned} \text{b) } 34^7 \times 34^{60} &= 34^{7+60} \\ &= 34^{67} \end{aligned}$$

Remember exponents are attached to what they are beside:

$$\begin{aligned} -2^3 &= -(2 \times 2 \times 2) \\ &= -8 \end{aligned}$$

$$\begin{aligned} (-2)^3 &= (-2 \times -2 \times -2) \\ &= -8 \end{aligned}$$

$$\begin{aligned} -5^2 &= -(5 \times 5) \\ &= -25 \end{aligned}$$

$$\begin{aligned} (-5)^2 &= (-5 \times -5) \\ &= 25 \end{aligned}$$

Very important when you have neg. base and even exponent

Dividing Powers with the same Base:

$$\begin{aligned} \text{Simplify } \frac{3^7}{3^5} &\rightarrow 3^7 \div 3^5 \\ &= 3^{7-5} \\ &= 3^2 \end{aligned}$$

State a rule for dividing powers with the same base:

$$\Rightarrow \frac{a^n}{a^m} = a^{n-m}$$

Ex 1: Simplify

$$\begin{aligned} \text{a) } \frac{107^{23}}{107^{10}} &= 107^{23-10} \\ &= 107^{13} \end{aligned}$$

$$\begin{aligned} \text{c) } \frac{(-3)^7}{(-3)^5} &= (-3)^{7-5} \\ &= (-3)^2 \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{5^{50}}{5^{20}} &= 5^{50-20} \\ &= 5^{30} \end{aligned}$$

$$\text{d) } \frac{200^{300}}{200^{299}} = 200$$

Power of a Power

$$\text{Simplify: } (7^3)^2 = 7^6$$

State a rule for power of a power:

$$\Rightarrow (a^n)^m = a^{n \times m}$$

Ex 1: Simplify

$$\begin{aligned} \text{a) } (3^2)^4 \\ &= 3^8 \end{aligned}$$

$$\begin{aligned} \text{b) } (15^2)^5 \\ &= 15^{10} \end{aligned}$$

Connecting the laws of exponents:

## Power Of a Product

(notice bases are different)

$$(a \times b)^m = (a)^m (b)^m$$

## Power of a Quotient

(notice bases are different)

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

exponent goes to each part of the base

ie:

$$(xy)^3 = x^3 y^3$$

$$\left(\frac{x}{y}\right)^3 = \frac{x^3}{y^3}$$

Putting the Exponents Laws together

Simplify:

$$\begin{aligned} \text{a) } 5(5^3) \div 5^3 &= 5^4 \div 5^3 \\ &= 5^{4-3} \\ &= 5 \end{aligned}$$

$$\begin{aligned} \text{c) } \frac{(8^4)^5}{8^2(8^6)} &= \frac{8^{20}}{8^8} \\ &= 8^{12} \end{aligned}$$

$$\begin{aligned} \text{e) } \left(\frac{4}{9}\right)^7 \left(\frac{4}{9}\right)^3 \div \left(\frac{4}{9}\right)^7 &= \left(\frac{4}{9}\right)^{10} \div \left(\frac{4}{9}\right)^7 \\ &= \left(\frac{4}{9}\right)^3 \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{(6^8)(6^3)}{6^7} &= \frac{6^{11}}{6^7} \\ &= 6^4 \end{aligned}$$

$$\begin{aligned} \text{d) } \left(\frac{9(9^6)}{9^3}\right)^5 &= \left(\frac{9^7}{9^3}\right)^5 \\ &= (9^4)^5 \\ &= 9^{20} \end{aligned}$$

$$\begin{aligned} \text{f) } \left(\frac{2}{7}\right)\left(\frac{2}{7}\right)^5 &= \left(\frac{2}{7}\right)^6 \end{aligned}$$

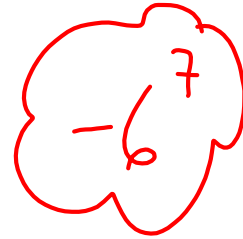
Ex 2: Simplify

$$\begin{aligned} \text{a) } (y(y^3))^4 \\ &= (y^4)^4 \\ &= y^{16} \end{aligned}$$

$$\begin{aligned} \text{b) } \frac{c(c^{12})c^5}{c^6} \\ &= \frac{c^{18}}{c^6} \\ &= c^{12} \end{aligned}$$

Ex 3 Now think about this one..

$$\begin{aligned} (-6)^3 \times 6^4 &= \\ &= [(-1)(6)]^3 \times 6^4 \\ &= (-1)^3 (6)^3 \times 6^4 \\ &= (-1)^3 (6)^7 \\ &= -(6)^7 \end{aligned}$$

**Changing the Base**Ex 1: Write each power with the following base:

a) base of 2	b) base of 3	c) base 3	d) base of $\frac{1}{5}$
$(4)^7$	$(9)^4$	$(27)^5$	$\left(\frac{1}{25}\right)^4$
$= (2^2)^7$	$= (3^2)^4$	$= (3^3)^5$	$= \left(\frac{1}{(5)^2}\right)^4$
$= 2^{14}$	$= 3^8$	$= 3^{15}$	$= \left(\frac{1}{5}\right)^8$

Ex 2: Simplify using the exponent laws

$$\begin{aligned} \frac{27^5}{9^4} &= \frac{(3^3)^5}{(3^2)^4} \\ &= \frac{3^{15}}{3^8} \\ &= 3^7 \end{aligned}$$

(Assigned Work)

P 399 # 1,2,3 (d), 5, 7-9(cd),  
10, 11d, 13, 14

